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INTERACTIVE SEA/SHORE BILLET ROTATION MODEL

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INTERACTIVE SEA/SHORE BILLET ROTATION MODEL

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An interactive model (BILROT) was developed for use by billet planners in allocating enlisted billets by rate/rating between sea and shore to achieve balanced rotation flows. The model also determines (1) the number of shore billets available for women enlisted or civilians without impacting male rotation, and (2) appropriate tour lengths given current or future allowance structures. The interactive capability allows the user to access any of a series of reports for a multiyear planning horizon.

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FOREWORD

This research and development was conducted in support of Exploratory Development Task Area ZF55.521.001.010, Manpower Management Decision Technology. The overall objective of this task area is to develop techniques to improve the Navy's managerial decision-making capabilities. This report concerns the development of an interactive model to allocate enlisted billets to sea and shore or to adjust sea/shore tour lengths to achieve rotation equilibrium. The Deputy Chief of Naval Operations (Manpower), OP-104, is currently using the model to address a variety of Congressional- and POM-inspired questions concerning the impact of rotation policies. A User's Guide is provided in NPRDC Technical Note 78-17, Note 1.

Acknowledgments are due to LCDR George Council, OP-104, for his overall guidance and to Mr. Robert Hartley, Systems Development Corporation, San Diego, for his programming assistance.

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SUMMARY

Problem

A significant Navy sea/shore rotation problem is the determination of a rate/rating's "sea" and "shore" billet or allowance structure such that rotation flows in each direction are approximately equal. The method used by OP-104 since 1972 has methodological deficiencies which produce results that can misallocate billets.

Purpose

The purpose of this effort was to develop an interactive sea/shore billet rotation (BILROT) model that more accurately computes enlisted sea and shore allowance structures by rate/rating.

Approach

The development of the model was based on three concepts--personnel flows, rotatable populations, and level of detail. These concepts are supported by assumptions about the enlisted rotation and personnel systems and sea/shore population characteristics.

Results

The new BILROT model is capable of calculating a sea/shore billet structure for each rate/rating that, given a prescribed tour ratio, would produce equal rotation personnel flows. In addition, the model can determine if (and how many) shore billets can be converted to civilian or women enlisted positions. Finally, it can suggest appropriate tour lengths given current or future allowances. The results are provided for the current month, fiscal year, and 5 future fiscal years. The interactive capabilities allow user control over the reports desired.

The BILROT model is currently being used in OP-104 in connection with rotation billet management.

Conclusions

The BILROT model produces a wider variety of rotation planning information and has a longer planning horizon than the former method. In addition, it does not over- or understate the billet changes necessary to produce equal rotation flows.

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INTRODUCTION

Problem

The rotation of enlisted personnel between sea and shore billets is an established Navy policy. One problem in rotation management has been the determination of a sea/shore billet structure that achieves approximately equal rotation flows between sea and shore. Since 1972, the Chief of Naval Operations (OP-01) has used a sea/shore billet rotation model (SEASHORE) to compute the enlisted sea and shore allowances applicable to a particular tour ratio for a given rate/rating. However, indirect users of the model, such as Bureau of Naval Personnel assignment officials, have complained that the results obtained using this model do not conform to actual experience. As a result, NAVPERSRANDCEN conducted a detailed documentation/validation of the SEASHORE model (Rowe & Smith, Note 2). Serious methodological and computational errors were discovered that could have resulted in significant misallocations of billets between sea and shore.

Purpose

The purpose of this effort was to develop an interactive sea/shore billet rotation model that more accurately computes enlisted sea and shore structures by rate/rating.

Background

Considerable research into sea/shore rotation billet allocation and tour length determination has preceeded this effort. Borgen and Thorpe (1967) and Conner, Thompson, and May (1966) studied the Navy's SEAVEY planning model, a system that permitted personnel to move to shore as existing shore tours expired and vacancies in shore billets became available. The rate of shore vacancies led to the determination of appropriate tour lengths. Problems in the implementation of the SEAVEY procedure were addressed by Borgen and Thorpe (1970); and methods for determining normal tour lengths, by Borgen and Thorpe (1970), Borgen, Segal, and Thorpe (1972), and Butterworth (1973).

METHODOLOGY

The methodology of the interactive sea/shore billet rotation model (BILROT) is based, in part, on the work of Borgen et al. (1972). Like any modelling effort, the BILROT model attempts to portray real phenomena by positing some limiting assumptions in order to be tractable. It is based on three general concepts--personnel flow, rotatable population, and level of detail. These concepts are supported by several assumptions about the enlisted rotation system in particular and the personnel system in general, the relationship between certain variables, and characteristics of the sea and shore populations. These concepts and assumptions are described in the remainder of this section.

Personnel Flow

Personnel rotation involves the transfer of personnel when they have completed a tour of some predetermined length. A billet vacancy is created each time personnel are rotated. Ideally, someone will be available for assignment to the vacated billet as he simultaneously completes his own tour, which, in turn, produces another billet vacancy that is filled by another move, and so on. Rotation, then, is simply a set of billet vacancies occurring regularly over time accompanied by a "flow" of personnel between two composites: collections of sea or shore duty types within a rate/rating.

These personnel flows are measured by "flow rates" that, given sea and shore rotatable inventories and some tour lengths, are fairly predictable. In fact, the model assumes that the number of people moving from one composite to the other each month is a function of the composite's rotatable inventory and the prescribed tour length in months. The relationship is expressed as:

$$F = R/T \tag{1}$$

where

R = Number of rotatable personnel,
T = Tour of length in months, and
F = Personnel flow rate per month.

In Figure 1, which illustrates this relationship, the personnel flow rate (F) is the portion of the rotatable population (R) that has moved during 1 month. As more times passes, the number of vacated billets increases until the complete tour length elapses, at which point the entire rotatable population will be completely displaced by a new population. Then, if the supply of vacated shore billets is set equal to the demand for vacated billets among the sea rotatable population, the personnel flow rates will be the same for both composites. This assumed relationship is displayed in Figure 2, where the slope of the hypotenuse represents the identical flow rate between the two populations. It implies that the rotation system is in "equilibrium" in the sense that the size of each composite will remain stable.

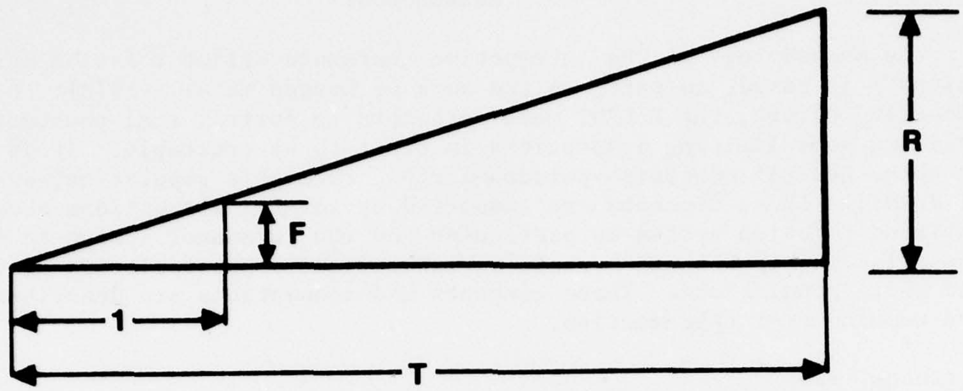

Figure 1. Personnel flow rate (F) shown as a function of rotatable inventory (R) and tour length in months (T). (Source: Borgen, Segal, and Thorpe, 1972.)

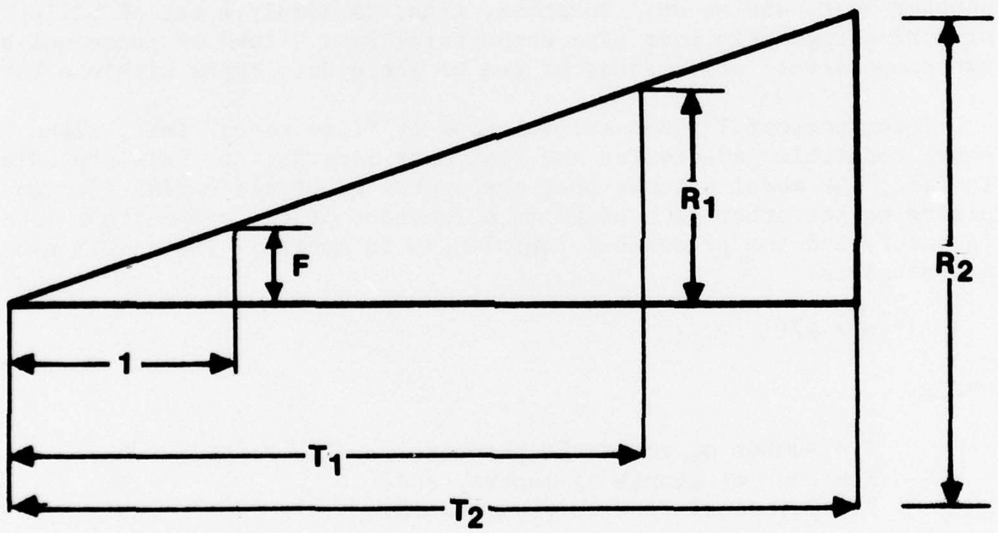

Figure 2. Personnel flow rates (F) as a function of the number of rotatables in each composite (R_1, R_2) and the proportional tour lengths in each composite (T_1, T_2). (Source: Borgen, Segal, and Thorpe, 1972.)

Stated differently:

$$R_1/T_1 = F_1 = F_2 = R_2/T_2 \tag{2}$$

where

R_1, R_2 = Number of rotatable personnel in the shore (1) and sea (2) composites respectively,

T_1, T_2 = Tour lengths in months for shore (1) and sea (2) respectively,

F_1 = Shore "vacancy rate" per month, and

F_2 = Sea "replacement rate" per month.

In actuality, of course, the rotation system (as viewed by one rate/rating or all rates/ratings) is seldom in exact equilibrium; that is, the flows of personnel between sea and shore are rarely equal. The "personnel flow concept" is important, however, because it enables the variables affecting the rotation process to be mathematically related. Thus, it can represent the ideal against which the present rotation process can be measured or proposed policies tested.

Rotatable Population

Not all personnel serving at sea or ashore at a particular time will necessarily rotate. Some personnel will be in special billets that are managed outside of normal rotation procedures, and others will attrite before completing their tours. Some may be promoted/demoted to another pay grade or "lateral" to another rating where a different tour length policy might apply, while still others may not be eligible because of insufficient obligated service. Hence, in modelling rotation, some assumptions must be made about the nature and size of the "rotatable populations" (R_1 and R_2 in equation (2) and Figure 2).

To predict the size of future rotatable sea populations, the SEASHORE model uses "survivor rates," which indicate the portion of an original population (cohort) remaining after some elapsed time. Survivor rates are illustrated by survivor curves as in Figure 3, which indicates, for instance, that, after 60 months, only 51 percent of the original population will remain. Put in a rotation context, if the sea tour were 60 months, only 51 percent of the original sea population would be available for rotation at the completion of the tour. The complement to survivor rates is the portion of the original force that has been "lost" to another pay grade or rating, or to the force as a whole.

The SEASHORE model is deficient in that it does not include promotions, demotions, or lateral assignments into a pay grade to fill sea billets vacated by "losses" (as determined by survivor rates), either explicitly or implicitly. (This problem does not exist in the shore composite, since it is assumed that there are no "losses" there.) Visually, the SEASHORE model's sea rotation queue (for each rate/rating) is as shown below:

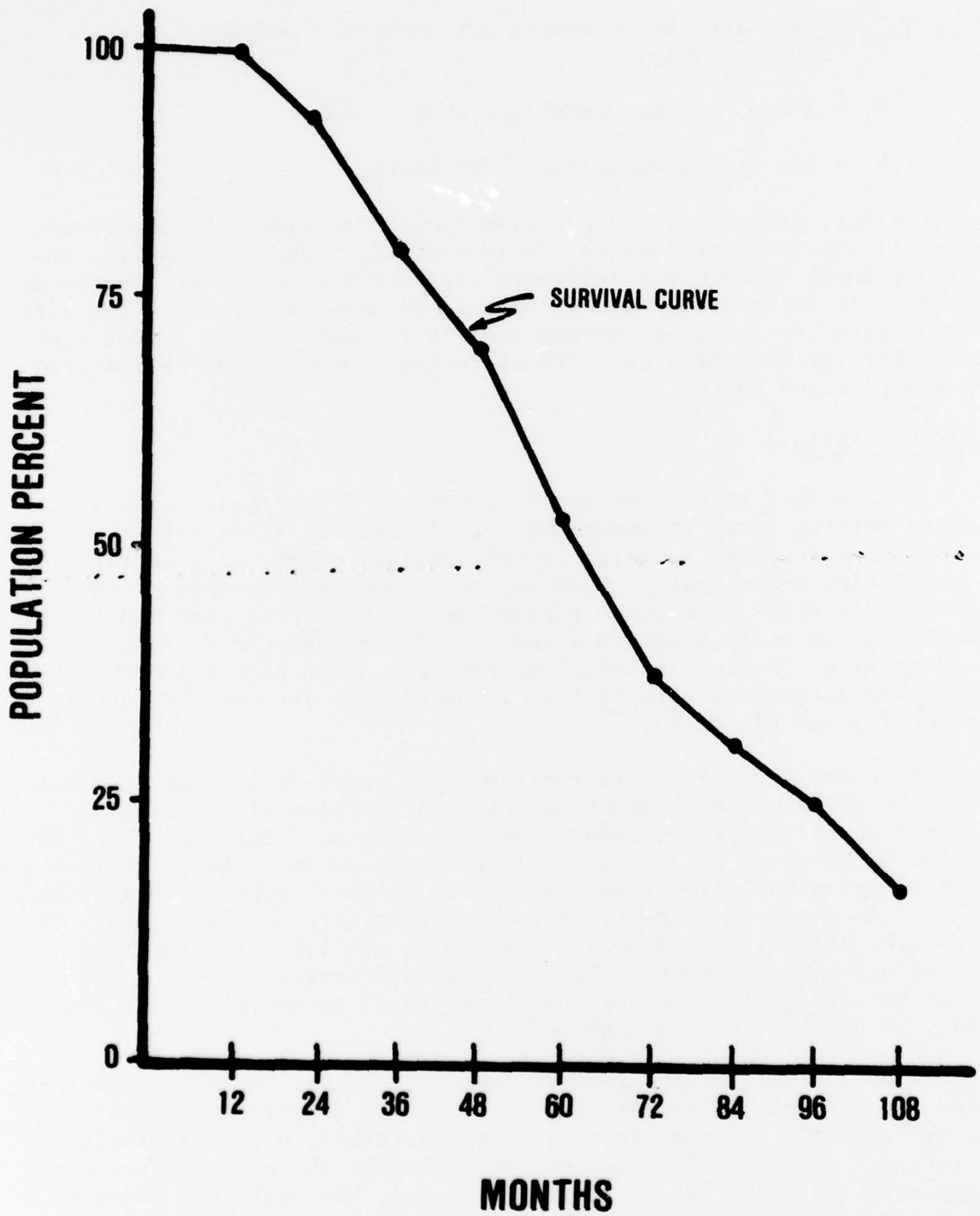

Figure 3. Population survivor curve.

		X	→	Rotate
Attrite	←	X		
		X		
		X		
Attrite	←	X		
		X		
Promotion-out	←	X		

Since the model does not consider promotions, demotions, or laterals into a pay grade in filling most, if not all, of the loss-created vacancies, the number of rotatable personnel at sea is understated by *roughly* the number of personnel that attrite or are "lost" to another rate/rating. This, in turn, causes the model to miscalculate the number of shore billets needed to maintain equal personnel flows between sea and shore (for a given set of tour lengths and sea billet requirements).

To overcome this deficiency, BILROT assumes that there is sufficient in-flow to fill billets vacated by attrition/advancement and that this in-flow is distributed along the sea rotation queue in a random manner. In other words, an individual flowing in will have already spent some time at sea; thus, he will be placed at the spot determined by that amount of time. With this assumption, the use of survival rates is no longer applicable, since the random flow in cancels the random losses.[1] The sea queue (or shore queue) now looks like this:

		X	→	Rotate
Attrite	←	X	←	Promotion-in
		X		
		X		
Attrite	←	X	←	Lateral-in
		X		
Promotion-out	←	X	←	Promotion-in

In determining the size of a rate/rating's rotatable population, losses have been accounted for by assuming that out-flows (losses) are filled by similar in-flows. However, even after losses are considered, there are still constraints that prevent all personnel from rotating. For example, some personnel serve the required time at sea or shore, but do not rotate because they lack sufficient remaining obligated service. While the exact proportion of these people to the total sea or shore population differs *among* rate/ratings, it is reasonable to assume that the ratio of rotatable personnel to the total population is the same for both sea and shore *within* a rate/rating. Stated mathematically:

$$R_1/N_1 = R_2/N_2$$

where,

[1] It is no longer necessary to assume that there are no "losses" in the shore composite since, by assumption, vacancies are now filled by promotions, laterals, etc. in flow.

R_1, R_2 = Number of rotatable personnel in shore (1) and sea (2) composites respectively, and

N_1, N_2 = Total populations of shore (1) and sea (2) composites respectively.

Then, from (2) (i.e., the equilibrium flow relationship), it follows that:

$$N_1/N_2 = R_1/R_2 = T_1/T_2.$$

This assumption has allowed the use of total sea and total shore populations in the BILROT calculations.

Level of Detail

In its computations, the BILROT model uses the aggregates "sea allowances/strengths" and "shore allowances/strengths." These composites are derived by summing over several types of duties as follows:

SHORE COMPOSITE (Rate/Rating = TYPE DUTY 1 + TYPE DUTY 6
SEA COMPOSITE (Rate/Rating) = TYPE DUTY 2 + TYPE DUTY 3 + TYPE DUTY 4

where

Type Duty 1 (Shore Duty) includes CONUS shore duty, Fleet shore duty, and certain Fleet activities considered shore duty for rotation;

Type Duty 2 (Arduous Sea Duty) includes ships, staffs, and other mobile units that spend considerable periods at sea away from their homeport during local operations, and that, when deployed overseas, operate at sea extensively;

Type Duty 3 (Overseas Shore Duty) includes shore activities outside the CONUS where the prescribed DoD-accompanied tours are less than 36 months;

Type Duty 4 (Toured (nonrotated) Arduous Sea Duty) includes nonrated ships, staffs, and other mobile units homeported outside CONUS excepting Alaska and Hawaii, ships or staffs with 12-month unaccompanied tours, and SSBN submarines; and

Type Duty 6 (Preferred Overseas Shore Duty) includes shore-based overseas activities where suitable family accommodations are available and the prescribed DoD-accompanied tours are 36 to 48 months, in recognition of the desirability of this duty.

Type Duty 5 (Preferred Sea Duty) is considered neutral duty and hence is not included in rotation analysis.

MODEL OUTPUTS

The BILROT model attempts to give the rotation planner more flexibility by producing a variety of rotation information over a much larger planning horizon. In addition, the model's interactive capability allows considerable user control over model output: The main expertise required for "running" the model is a knowledge of the underlying rotation problem and not computer operating systems. (A User's Guide to the BILROT model appears in Rowe & Smith, Note 2.)

Specific attributes of the BILROT model are discussed in the remainder of this section.

Shore Allowance Changes

The BILROT model, like the original SEASHORE billet rotation model, calculates the positive or negative change (augmentation) to the shore billet structure of a rate/rating that would be required to maintain equal flows of personnel between sea and shore, given sea and shore allowances, and prescribed or hypothetical tour length ratios. The rotation planner is interested in the number of shore billets he can eliminate from rotation (without impacting male rotation), because those billets might then be assigned to enlisted women or civilians.

The SEASHORE shore billet change procedure, called SHAUG (for "shore augmentation"), is written as:

$$\mathrm{SHAUG} = \frac{\mathrm{SEALO*REEN}}{\mathrm{TOURRATIO}} - \mathrm{SHRALO} \tag{3}$$

where

SEALO	=	Sea allowance
SHRALO	=	Shore allowance
REEN	=	"Reenlistment" rate[2]
TOURRATIO	=	Sea tour length (months)/shore tour length (months)

---

[2]The "reenlistment rate" (REEN) is used to determine the portion of the sea population eligible for rotation and hence demanding shore billets. Eligiblity for rotation implies both completing the sea tour and having remaining obligated service greater than the obligation factor applicable to the particular rate/rating. The combination of these two factors often produces a time obligation that is not measured in whole years like a survival rate table. Hence, the REEN is simply an extrapolation between the survival rates applicable to the two nearest whole years. In fact, it is simply a weighted average of the two rates where the closer the time to one rate, the greater its weight.

Equation (3) can be rearranged to restate the equilibrium flow relationship of equation (2):

$$\frac{\text{SHRALO + SHAUG}}{\text{SHORE TOUR LENGTH}} = \frac{\text{SEALO*REEN}}{\text{SEA TOUR LENGTH}} \tag{4}$$

Since BILROT does not use survival rates to determine a composite's rotatable population, the BILROT shore billet change procedure, called NEWSHAUG (for "new shore augmentation") does not include these rates. NEWSHAUG is determined as follows:

$$\text{NEWSHAUG} = \frac{\text{SEALO}}{\text{TOURRATIO}} - \text{SHRALO} \tag{5}$$

or, written to give the equilibrium flow ratio:

$$\frac{\text{SEALO}}{\text{SEA TOUR LENGTH}} = \frac{\text{SHRALO + NEWSHAUG}}{\text{SHORE TOUR LENGTH}} \tag{6}$$

As shown in Table 1, a characteristic of NEWSHAUG is that it eliminates fewer (never more) billets than the original SHAUG when a reduction of shore billets is indicated (i.e., NEWSHAUG is less negative than SHAUG), and it adds more (never less) billets than the original SHAUG when an increase in shore billets is indicated. This occurs because SHAUG, by using survivor rates but not accounting for promotion, etc., in flow, understates the rotatable sea population, which, in turn, understates the number of shore billets necessary to support the sea's rotatable population.

Table 1

SHAUG/NEWSHAUG Comparison by Selected Ratings/Rates

Pay Grade	Rate	Code	Prescribed Sea/Shore Tour Ratio Months	Billet Change SHAUG	Billet Change NEWSHAUG
E-9	BMCM	0100A	48:31	- 66	- 65
E-9	ETCM	1000A	36:48	- 8	0
E-5	SM2	02503	72:26	-169	- 38
E-8	OSCS	0300J	42:30	+ 40	+ 49
E-6	BM1	01002	72:30	-752	-625

Note: The rates in this table are used only as examples and do not represent extreme cases.

Note that, in the higher pay grades shown in Table 1 (e.g., BMCM, ETCM), the NEWSHAUG and SHAUG values are very similar. The understatement of necessary shore billets is very small, since few personnel assigned to fill vacancies in these grades are unaccounted for. Alternatively, in lower pay grades (e.g., BM1, SM2), the survivor rates are much less than 100 percent. As a result, the number of vacancies and, hence, the number of in-flows not accounted for by SHAUG are much greater. Consequently, the number of necessary shore billets is largely understated.

Sea/Shore Allowances

As mentioned above, the NEWSHAUG computation indicates the number of shore billets that could be "eliminated" from (or added to) a rate/rating's rotation structure to produce equal sea/shore personnel flows. However, in many rate/ratings, it may be impossible to substitute civilian or military women. In addition, because of budget or workload constraints, it may be difficult to alter a rate/rating's total allowance. In these cases, the BILROT model redistributes billets between sea and shore composites while maintaining equal sea/shore personnel flows. The following example demonstrates this process.

In the BM rating, pay grade E-9:

Sea Allowance (SEALO) = 46
Shore Allowance (SHRALO) = 90
Tour Ratio (TOURRATIO) = 48/31 = 1.55

$$\text{hence, NEWSHAUG} = \frac{46}{1.55} - 90 = -60.$$

Then, given the tour ratio, removing the recommended 60 shore billets makes the personnel flows between sea and shore equal. In other words, the following relationship (Equation 2) is satisfied:

$$\frac{\text{SEALO}}{\text{SEA TOUR LENGTH}} = \frac{46}{48} = \frac{30}{31} = \frac{\text{SHRALO}}{\text{SHORE TOUR LENGTH}} .$$

However, suppose, instead of eliminating 60 shore billets, they are redistributed between sea and shore allowances such that the above ratios remain equal. Since the share that goes to each is unknown, let

$$\begin{aligned} X &= \text{shore billets to sea} \\ Y &= \text{shore billets to shore} \\ X + Y &= 60. \end{aligned} \tag{7}$$

The billets must be redistributed such that rotation flows remain equal, or

$$\frac{\text{SEALO} + X}{\text{SEA TOUR LENGTH}} = \frac{(\text{SHRALO-NEWSHAUG}) + Y}{\text{SHORE TOUR LENGTH}} . \tag{8}$$

Then, rewriting (7) in terms of only one unknown, X, produces

$$X = 60 - Y. \tag{9}$$

Then, substituting into (8) yields

$$\frac{46 + (60-Y)}{48} = \frac{30 + Y}{31} . \tag{10}$$

Cross-multiplying, and solving for Y yields

$$Y = 23, \text{ hence } X = 60 - 23 = 37.$$

This creates the following new allowances:[3]

SEALO = 46 + 37 = 83
SHRALO = 30 + 23 = 53.

Figure 4 shows a portion of the model output that displays, for a rate/rating (in this case, BMCM), the original sea/shore allowance structure, the new allowance structure dictated by a variety of tour ratios,[4] the increase/decrease in sea and shore billets needed to arrive at these new allowances, and, finally, the NEWSHAUG values for all tour ratios.

---

[3]Such a redistribution may not be possible, since such an addition to sea allowances may exceed budget limits and such a subtraction from the shore composite may eliminate functions that cannot be spared. The calculation does, however, provide a way to establish the range of possibilities from elimination to redistribution to achieve equal sea/shore flows. The likely solution would be some point within that range; that is, a combination of eliminating billets that are expendable and a redistribution of others given budget constraints.

[4]Figure 4 displays 11 tour ratios commonly prescribed by planners. The user may request information on all or just one of these 11 or even input a ratio not found there.

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ALLOWANCES AS OF 4-78

RATE CODE	RATE ABBRE.	SEA ALLOWANCE	SEA STRENGTH	SHORE ALLOWANCE	SHORE STRENGTH	MANNING LEVELS SEA	MANNING LEVELS SHORE
0100A	BMCM	46	42	90	71	0.91	0.79

SEA/SHORE TOUR ALT.	TOUR RATIO	NEW ALLOWANCE SEA	NEW ALLOWANCE SHORE	SEA BILLET CHANGE INCREASE	SEA BILLET CHANGE DECREASE	SHORE BILLET CHANGE INCREASE	SHORE BILLET CHANGE DECREASE
36/36	1.00	68	68	22	0	0	22
48/36	1.33	77	59	31	0	0	31
48/30	1.60	83	53	37	0	0	37
48/24	2.00	90	46	44	0	0	44
60/24	2.50	97	39	51	0	0	51
42/36	1.17	73	63	27	0	0	27
42/30	1.40	79	57	33	0	0	33
42/24	1.75	86	50	40	0	0	40
54/36	1.50	81	55	35	0	0	35
54/30	1.80	87	49	41	0	0	41
54/24	2.25	94	42	48	0	0	48

Figure 4. BILROT model output displaying new allowance structures for selected tour ratios.

Sea/Shore Tour Alternatives

Recall once more that the BILROT model seeks the following relationship that equates sea and shore personnel flows:

$$\frac{\text{SEALO}}{\text{SEA TOUR LENGTH}} = \frac{\text{SHRALO}}{\text{SHORE TOUR LENGTH}} \,. \tag{11}$$

So far, it has done this only by changing the sea and shore billet configurations to make the above ratios equal. Another method is to alter the sea/shore tour ratio to equal the ratio of sea allowances to shore allowances. Rearranging (11) produces:

$$\frac{\text{SEA TOUR LENGTH}}{\text{SHORE TOUR LENGTH}} = \frac{\text{SEALO}}{\text{SHRALO}} \,. \tag{12}$$

The model has two approaches to adjusting the tour ratio. The first holds the sea tour constant at a CNO-objective of 36 months and alters the shore tour length until the ratio equals the given sea/shore allowance ratio. This is accomplished by:

$$\frac{\text{SEA TOUR LENGTH (36)}}{\text{SHORE TOUR LENGTH}} = \frac{\text{SEALO}}{\text{SHRALO}} \,. \tag{13}$$

Using the BMCM rate/rating again as an example, this technique can be demonstrated:

$$\frac{36}{\text{SHORE TOUR LENGTH}} = \frac{46}{90} \,.$$

So SHORE TOUR LENGTH = 71 months.

The result of this example is a rather long shore tour, one that may well be unacceptable. However, the result does provide the appropriate <u>ratio</u> of sea and shore tour lengths: 36/71 = 0.51.

The second method for adjusting the tour ratio to produce equal rotation flows is to alter <u>both</u> the sea and shore tour lengths, while keeping the length of the rotation "cycle" (sea tour + shore tour) fixed at 72 months. (This corresponds to 36 month tours for both sea and shore--the CNO objective.)

The method is demonstrated below using the BMCM example:

$$\frac{A}{B} = \frac{46}{90} \tag{14}$$

where:

A = sea tour length,
B = shore tour length, and
$A + B = 36 + 36 = 72$ months.

Then, writing A in terms of B:

$$A = 72 - B. \tag{15}$$

Substituting this into (14) yields

$$\frac{72 - B}{B} = \frac{46}{90} .$$

Then, B, the shore tour length, is 48 months, while the sea tour length should be 72 - 48 = 24 months.

Figure 5 shows a complete model output for a rate/rating (BMCM), including the new allowance structures for various tour ratios and the two suggested sea/shore tour configurations based on the given allowance structure. In this printout, NEWSHAUG values for each tour ratio are listed as "Possible Civilian and/or Female Shore Billets."

Finally, the BILROT model can produce these reports for any rate/rating for the current month, as of the end of the current fiscal year, or as of the end of the next 5 fiscal years. This capability was developed to help answer "what if"-type questions commonly asked during POM development and defense.

Rowe and Smith (Note 1) describes how any or all of the information described in this section can be obtained.

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RATE CODE	RATE ABBRE.	SEA ALLOWANCE	SEA STRENGTH	SHORE ALLOWANCE	SHORE STRENGTH	MANNING LEVELS SEA	MANNING LEVELS SHORE
0100A	BMCM	46	42	90	71	0.91	0.79

---SEA/SHORE TOUR ALT.	TOUR RATIO	NEW ALLOWANCE SEA	NEW ALLOWANCE SHORE	SEA BILLET CHANGE INCREASE	SEA BILLET CHANGE DECREASE	SHORE BILLET CHANGE INCREASE	SHORE BILLET CHANGE DECREASE
36/36	1.00	68	68	22	0	0	22
48/36	1.33	77	59	31	0	0	31
48/30	1.60	83	53	37	0	0	37
48/24	2.00	90	46	44	0	0	44
60/24	2.50	97	39	51	0	0	51
42/36	1.17	73	63	27	0	0	27
42/30	1.40	79	57	33	0	0	33
42/24	1.75	86	50	40	0	0	40
54/36	1.50	81	55	35	0	0	35
54/30	1.80	87	49	41	0	0	41
54/24	2.25	94	42	48	0	0	48

-SEA/SHORE TOUR GIVEN
SEA TOUR = 36 ; BILLET RATIO = 0.51

SEA	SHORE
36	70

FIXED CYCLE AND BILLET RATIO-
SEA/SHORE TOUR GIVEN ALTERNATIVE36/36

SEA	SHORE
25	47

POSSIBLE CIVILIAN AND/OR FEMALE SHORE BILLETS

TOUR1	TOUR2	TOUR3	TOUR4	TOUR5	TOUR6	TOUR7	TOUR8	TOUR9	TOUR10	TOUR11
44	55	61	67	71	50	57	63	59	64	69

Figure 5. Complete BILROT model output.

CONCLUSIONS

In conclusion, then, the BILROT model provides considerably expanded rotation planning capabilities over those of the previous SEASHORE model. SEASHORE simply calculated the change required in a rate/rating shore billet to produce rotation equilibrium. Alternatively, BILROT determines the number of shore billets within each rate/rating that could be turned over to civilians or filled by women enlisted, calculates new sea/shore billet structures given a variety of tour schemes, computes a set of suggested tour policies to fit the current allowance structure of a rate/rating, expands the planning horizon to include current authorizations (current month) and 5 future years. In addition, BILROT's interactive features permit substantially more control over the output desired. Consequently, OP-104 is currently using the model to address a variety of Congressional- and POM-inspired questions regarding the impact of rotation policies.

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